

Moore, Keara

From: Robin, George
Sent: Friday, January 31, 2014 3:29 PM
To: Robin, George
Subject: (Seismic FOIA) (Salton Sea referenced) Fracking and energy exploration connected to earthquakes, say studies

From: Robin, George
Sent: Thursday, July 11, 2013 2:49 PM
To: Truschel, Jack; Johnson, Liz
Cc: Albright, David; Robin, George
Subject: (Salton Sea referenced) Fracking and energy exploration connected to earthquakes, say studies

Hi Liz and John,

It has been a while since we communicated, so I perked up when I read the article below.

Can we discuss this at your convenience? We can make an agenda of discussion items as well, since this subject may be quickly resolved.

Let me know, thanks.

George

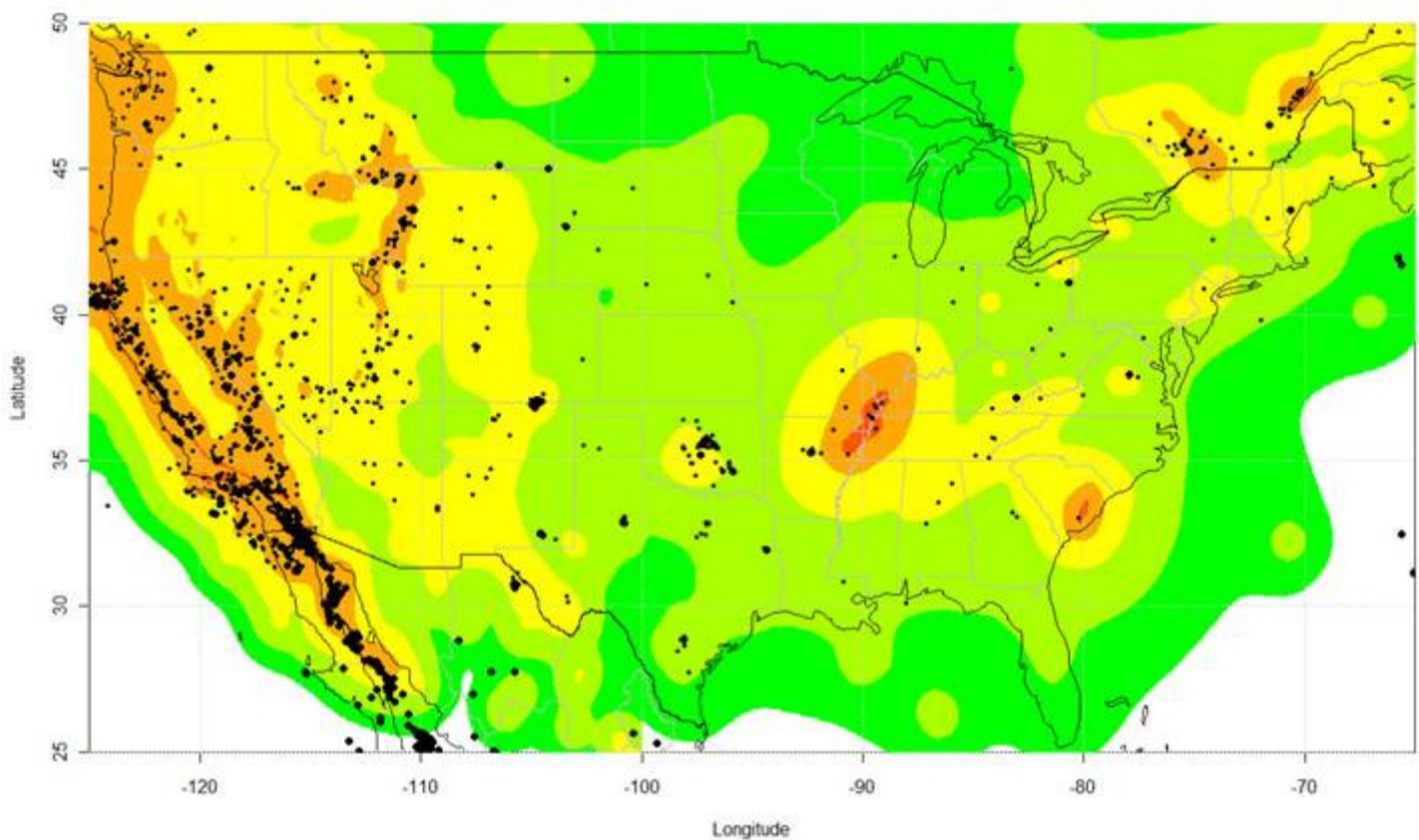
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<http://www.nbcnews.com/science/fracking-energy-exploration-connected-earthquakes-say-studies-6C10604071#fracking-energy-exploration-connected-earthquakes-say-studies-6C10604071>

Fracking and energy exploration connected to earthquakes, say studies

John Roach NBC News



Science / AAAS

Seismicity of the coterminous United States and surrounding regions for the period 2009 to 2012. Black dots denote seismic events. Only earthquakes equal to or exceeding Mw 3.0 are shown; larger symbols denote events equal to or exceeding Mw 4.0.

The rivers of water pumped into and out of the ground during the production of natural gas, oil and geothermal energy are causing the Earth to shake more frequently in areas where these industrial activities are soaring, according to a series of studies published today. While the gas extraction process known as hydraulic fracturing (aka "fracking") causes some small quakes, it's the disposal of wastewater following that process — and many others relating to energy production — that lead to the largest tremors.

"Fortunately, there have been no deaths and damage has been limited to date, but it is obviously of concern to people as we think about the future of the energy economy," [William Ellsworth](#), a seismologist with the United States Geological Survey in Menlo Park, Calif., told NBC News.

Within the central and Eastern United States, more than 300 earthquakes of magnitude 3 or greater were recorded from 2010 through 2012, compared to an average rate of 21 earthquakes per year from 1967 to 2000, he noted in a review study on human-induced earthquakes published today in [Science](#).

In southern California, researchers have found a correlation between seismic activity and a geothermal power plant that pumps water out of an underground reservoir to produce steam that spins electricity generating turbines and then returns most of the water back underground.

Most of the earthquakes at the Salton Sea geothermal field are tiny, but there is "a very small probability, extremely small but nonzero probability, of triggering the 'big one'" on the San Andreas fault, [Emily Brodsky](#), a geophysicist at the University of California, Santa Barbara, told NBC News.

The papers "continue the dialogue on induced seismicity, which is great," [Julie Shemeta](#), founder and president of MEQ Geo, a consulting firm on seismic hazards with various clients in the petroleum industry, told NBC News. But, she added, "I don't think this is a huge red light."

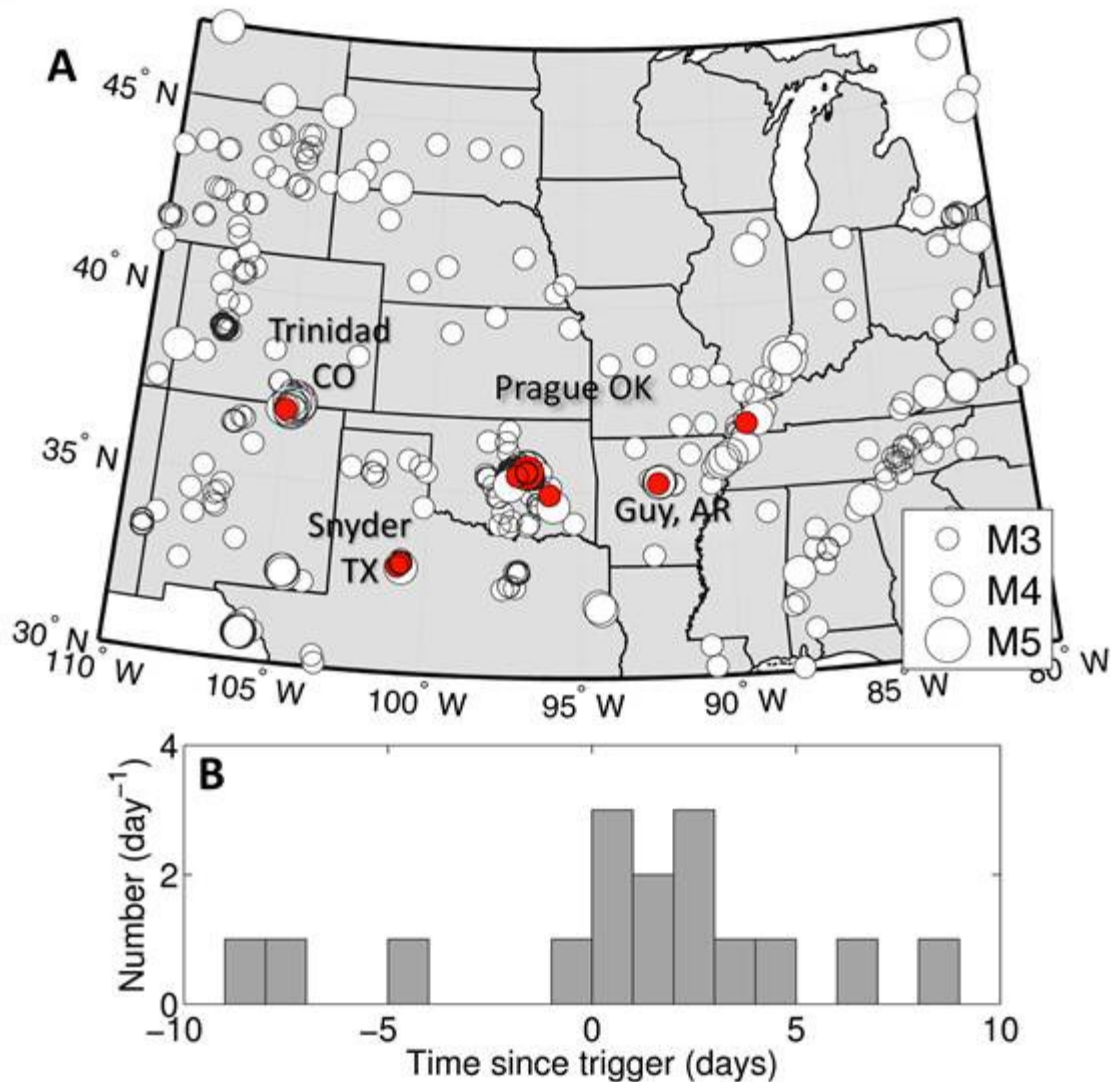
Shemeta was a member of a [Natural Research Council committee that issued a report in 2012](#) finding that the practice of fracking poses scant risk of triggering damaging earthquakes, but called for further research into the issue.

Size matters

Scientists have known for several decades that human activity can cause the ground to shake, but the rise in earthquake frequency paralleling the rise in production of oil and gas from shale rock formations has made the issue a hot topic, Ellsworth noted.

For one, scientists don't know how big — and thus deadly — these induced earthquakes can be. "We know a lot about the process that starts an earthquake — both natural and man-made ones — but what is really difficult for us to understand at this point is how far they will run once they get started," he said.

Most induced earthquakes, like natural ones, are tiny, Ellsworth said. But a few have been large enough to feel and caused minor damage, including a magnitude [5.7 event near Prague, Okla., on Nov. 6, 2011](#), that destroyed 14 homes and injured two people. Another study, published in Science, linked it to an injection well used to dispose wastewater from oil operations.



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Remote triggering in the Midwestern United States. (A) Catalogued earthquakes above Mw 3.0 between 2003 and 2013 (Advanced National Seismic System catalog). Earthquakes in red occurred after the first ten days following the Maule earthquake in Chile (February 2010), the Tohoku-Oki earthquake in Japan (March 2011), or the Sumatra earthquakes (April 2012).

In that case, evidence suggests the earthquake was triggered by a series of events that started with seismic waves from the [magnitude 8.8 earthquake in Chile on Feb. 27, 2010](#), nearly two years earlier.

Seismic waves from these distant, major earthquakes occur over "too slow, too long a period to be felt by humans but they can have a pretty large effect on squeezing the rock," [Nicholas van der Elst](#), a researcher at Columbia University's Lamont-Doherty Earth Observatory, explained to NBC News.

Van der Elst and colleagues present evidence in Science for this phenomenon — called "triggered induced earthquakes" — occurring at the injection well near Prague and wells in western Texas and southern Colorado following major earthquakes in Japan in 2011 and Sumatra in 2012.

"They wouldn't have happened if there wasn't this pumping to raise the pore pressures, but then they would've happened sooner or later even without the trigger. The trigger makes them happen now as opposed to later," van der Elst said.

Fracking vs. wastewater injection

The fracking technique used to produce natural gas and oil involves shooting several million gallons of water laced with chemicals and sand deep underground to break apart chunks of shale rock, freeing trapped gas to escape through cracks and fissures into wells.

The process produces earthquakes that are almost all too small to be felt — the largest one linked directly to fracking is a magnitude 3.6 in the Horn River Basin of British Columbia, Canada, in 2009, Ellsworth noted in Science.

The larger earthquakes are associated with injection of wastewater into underground wells, a technique used to dispose of the briny, polluted water that comes to the surface after a frack job is completed and a well is producing natural gas and oil.

Several notable events, including a [magnitude 4 in Youngstown, Ohio, in 2011](#) and the Prague event are linked to wastewater injection wells. Besides disposing of wastewater in various industrial processes, these wells are also to prevent salty groundwater from reaching rivers.

Given the distinction between fracking and wastewater injection, one way to limit human-induced earthquake activity is to stop the practice of the latter. Already, the natural gas industry is working on improving its recycling of water and developing technologies to clean up wastewater sufficiently for discharge at the surface, Ellsworth noted.

But that fix won't work everywhere. In situations where saltwater injection must continue indefinitely, for instance, injections could be slowed or halted when seismic activity occurs in a bid to stave off an even larger quake.

"But you need to have the information to do it and at this point seismic monitoring in particular is very weak in many parts of the country where wastewater is being injected," Ellsworth said.

The geothermal element

Research done by Brodsky, the geophysicist studying quakes at the Salton Sea geothermal field, suggests that earthquakes are induced not just by injection, but also by changing the volume of fluid in the ground.

Taken together, the studies point to the difficult task of determining an acceptable level of risk for energy production, she said.

"You could imagine a scenario where we as a society decide that having a few earthquakes is a better situation and a more acceptable risk than global warming," she said. "But we are not actually in a position to evaluate that."

That position may come with more studies into the underlying causes of human-induced earthquakes and the ability of humans to prevent them. From the natural gas industry's perspective, these new studies are a step in the right direction.

"Credible data that provide a pathway to more responsible development are always worth considering," Steve Everley, a spokesman for [Energy in Depth](#), a natural gas industry group, said in a statement emailed to NBC News.